WHAT IS CLAIMED IS:

1. An apparatus having an x-ray head adjustable in at least three mutually transverse axes for directing x-rays from different positions toward a part, the apparatus comprising:

a frame for supporting the x-ray head;

an x-axis adjustment mount of the frame operably connected to the head for adjusting the head in an x-axis fore and aft direction;

a y-axis adjustment mount of the frame operably connected to the head for adjusting the head in a y-axis lateral direction; and

a z-axis adjustment mount of the frame operably connected to the head for adjusting the head in a z-axis vertical direction.

2. The apparatus of claim 1 wherein the frame includes a fixture portion adapted to removably attach the frame to the part to allow the x-ray head to be used on parts in the field.

3. The apparatus of claim 2 wherein the fixture portion includes adjustable clamps for removably attaching the frame to different sizes of cables with the adjustable clamps comprising the y-axis adjustment mount to allow the head to be located at different positions along the length of the cable.

4. The apparatus of claim 1 wherein the x, y, and z adjustment mounts include linear drives for linearly adjusting the head in three mutually perpendicular directions with the x and y adjustment mounts allowing the head to direct x-rays to a predetermined region on the part

and the z-adjustment mount allowing the focal distance of the head from the part to adjusted.

5. The apparatus of claim 1 wherein the frame and x, y, and z adjustment mounts are integrated in a portable x-ray diffraction unit for being transported to different part sites , and

a stand distinct from the portable unit for supporting the unit at a desired part site.

6. The apparatus of claim 5 wherein the unit and the stand have an adjustable attachment therebetween to allow the unit and stand to be shifted to different positions relative to each other.

7. The apparatus of claim 5 wherein the head includes detectors for sensing the x-rays off from the part, and

a controller connected to the head for receiving signals from the detectors and including circuitry adapted to generate maps of a strength related characteristic of the part at the part site with the strength related characteristic being based on the received signals.

8. The apparatus of claim 1 wherein the head includes an elongate housing having a longitudinal axis, and the frame includes an r-axis adjustment mount operably connected to the head for adjusting the head in an r-axis rotary direction about the housing axis to allow the head to direct x-rays at contoured parts.

9. The apparatus of claim 8 wherein the frame includes a phi-axis adjustment mount operably connected to the head for the adjusting the head in a phi-axis rotary direction transverse to the r-axis rotary direction.

10. The apparatus of claim 9 wherein the phi-axis adjustment mount is disposed forwardly in x-axis direction from the z-axis adjustment mount.

11. The apparatus of claim 1 including a touch sensor which is shifted into engagement with the part with the head a predetermined distance from the part in the z-axis direction, and

a controller signaled by the touch sensor for repeatable locating of the head at the predetermined distance from the part after use of the sensor.

12. The apparatus of claim 11 wherein the controller includes a teach mode to allow an operator to shift the touch sensor into engagement with the part at various locations thereon by shifting of the head via the adjustment mounts for mapping part contour so that the head precisely directs x-rays toward the part at the various locations along its contour.

13. The apparatus of claim 12 wherein the head includes an elongate housing having a longitudinal axis, and the frame includes an r-axis adjustment mount operably connected to the head for adjusting the head in an r-axis rotary direction about the housing axis to allow the head to focus x-rays at parts having contours including curved surfaces without moving the part.

14. An apparatus for directing x-rays at parts with curved surfaces, the apparatus comprising:

an x-ray head having an elongate housing including a longitudinal axis thereof;

a frame for supporting the x-ray head; and

an adjustment mount of the frame which allows the head to undergo rotary movement about the longitudinal axis thereof to substantially keep the head at a predetermined distance from a curved surface of a part at which x-rays are directed at various positions along the part curved surface.

15. The apparatus of claim 14 including a plurality of other adjustment mounts for moving the head in a plurality of different directions to allow the head to move in a path that substantially matches the contour along the part defined by the different positions at which x-rays are to be directed.

16. A method for obtaining measurements of strength related characteristics of a part, the method comprising:

providing a portable x-ray diffraction unit including an x-ray head having integrated adjustment mechanisms for shifting the head in a plurality of different directions;

transporting the portable unit to a site at which the part is in service;

orienting the x-ray head relative to the part for directing x-rays thereat;

shifting the x-ray head via the adjustment mechanisms to direct x-rays at various positions on the part for obtaining a sufficiently large distribution range of measurements of the desired part characteristics for proper strength analysis thereof;

detecting the diffraction of the x-rays from the part at the various positions thereon;

transmitting signals to a controller for the portable unit that are based on the detected x-rays;

interpreting the signals in circuitry of the controller to render measurements of at least one strength related characteristic of the part; and

generating a map at the part site of the part characteristic across the entire distribution range of measurements for the part.

17. The method of claim 16 including sensing when the head is shifted to a focus position a predetermined distance from the part, signaling the controller when the focus position has been reached, storing in memory of the controller the position of the adjustment mechanisms to keep the head at the focus position, and operating the adjustment mechanisms via the stored positions to precisely shift the head to the focus position in a repeatable manner.

18. The method of claim 17 wherein the positions on the part to be measured are on different level surfaces of the part or on curved surfaces of the part, an operator shifts the head to different positions from which it is desired to direct x-rays at the part positions via the adjustment mechanisms, storing the positions of the adjustment mechanisms associated with the different head positions in the controller for mapping a desired path of movement of the head for taking measurements from the different part positions, and causing the head to undergo the desired path of movement to allow measurements to be taken from complexly shaped parts without requiring movement thereof.

19. The method of claim 16 wherein the part includes a curved surface and the adjustment mechanisms include a rotary adjustment mechanism, and the x-ray head is shifted by rotating the head via the rotary adjustment mechanism

about an internal axis of the head to substantially maintain the head at a predetermined distance from the part curved surface for directing x-rays at positions thereon without requiring movement of the part.

20. The method of claim 16 including initializing the position of the head relative to the part, storing the part contour in a memory of the controller, and causing the head to shift from the initialized position by the adjustment mechanisms to keep a substantially constant distance from the part based on the stored part contour.

21. The method of claim 16 wherein the x-ray head is oriented relative to the part by mounting the unit to the part so that the part does not have to be taken out of service to obtain the strength related characteristics thereof.

22. The method of claim 21 wherein the part is a cable for a bridge, the unit is transported to a part site by transporting the unit to the bridge, and the unit is mounted to the part by releasably clamping the unit via a fixture thereof to the bridge cable.

23. The method of claim 16 wherein the part strength related characteristic is stress and the map is generated by creating a map curve line interconnecting the stress measurement for each position across the distribution range of positions measured on the part for graphically showing areas of stress concentration in the distribution range on the map.

24. A method of measuring strains on load bearing members while the members are subject to loads, the method comprising:

providing an x-ray diffraction apparatus;

mounting the apparatus to a load bearing member while it is subject to loading;

adjusting a fixture for the apparatus to the size of the load bearing member to be measured to allow the apparatus to be used with different sizes of load bearing members;

measuring the strains of the load bearing member with the apparatus.

25. The method of claim 24 wherein the load bearing members are wire rope, single strand or multi-strand cables supporting load bearing structures, or individual strands of a cable bundle or wire rope.

26. The method of claim 24 wherein the load bearing members are measured while in situ as tension members for bridge structures.

27. A method for taking x-ray diffraction measurements from parts having multi-level or curved surfaces, the method comprising:

providing a x-ray head that is shiftable in a plurality of different directions;

teaching a controller for the x-ray head the shape of a portion of a part from which measurements are desired; and

shifting the x-ray head under command of the controller in a predetermined path based on the taught shape of the part portion for directing x-rays at different

positions therealong while keeping the head at a substantially constant distance therefrom.

28. The method of claim 27 wherein the controller is taught the part portion shape by providing a remote control for use by an operator, operating the remote control to shift the head to the different positions from which x-rays are to be directed at corresponding different positions on the part portion, signaling the controller via the remote control with the different positions of the head, and storing the different positions in memory of the controller to define the predetermined path of travel of the head along the shape of the part portion.